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Selected Anthropometric, Cardiorespiratory, and Hematological Parameters in Health Care Personnel

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SELECTED ANTHROPOMETRIC, CARDIORESPIRATORY, AND HEMATOLOGICAL PARAMETERS IN HEALTH CARE PERSONNEL

by

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An Abstract

of a thesis submitted in partial fulfillment

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ABSTRACT

Fitness parameters of health-care employees and physicians at a small rural hospital were investigated. Subjects (N = 82), aged 22-75 years, were health-care deliverers at Tompkins Community Hospital in Ithaca, New York. The study examined anthropometric, cardiorespiratory, and hematological parameters of the two groups of subjects over a 4-month period. During this time they engaged in an exercise program that was developed according to the wellness concept, aiming at improved health through preventive medicine. The parameters of interest were body composition, blood pressure, cholesterol/HDL ratio, and maximum oxygen consumption ($\dot{V}O_{2max}$). The subjects were tested using the Balke (substandard) treadmill protocol. Results indicated that the parameters measured were not significantly (p > .05) different between the male employees of any age group and the male population in general. The female employee group (ages 30-39) had a significantly (p < .05) lower body fat percentage and diastolic blood pressure than the norm. The female employee group (ages 40-49) had a higher systolic blood pressure and body fat percentage than the general population of the same gender and age. The only difference between the physician group and age-matched controls was in body fat percentage, which was significantly (p < .05) lower in the 40-49 age group category. However, there was no significant difference observed between the employee and physician groups. For all the classifications studied, the mean for the cholesterol/HDL ratio was worse than the population

standard. While several of the *t* tests indicated significant differences, these tests represented only a small percentage of the total number of significance tests run in this study, a percentage certainly within the limits of chance established by the overall probability level for this study. Therefore, the results of this investigation indicate that no significant difference in the health/fitness status exists between these hospital allied health care professionals and the general population, at least as assessed by the parameters of body composition, blood pressure, cholesterol/HDL ratio, and aerobic capacity.

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A Thesis Presented to the Faculty of
the School of Health, Physical
Education, and Recreation
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In Partial Fulfillment of the
Requirements for the Degree
Master of Science

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by
Mary Eileen Bashara
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Ithaca College
School of Health, Physical Education, and Recreation
Ithaca, New York

CERTIFICATE OF APPROVAL

MASTER OF SCIENCE THESIS

This is to certify that the Master of Science Thesis of

Mary Eileen Bashara

submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Health, Physical Education, and Recreation at Ithaca College has been approved.

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DEDICATION

This thesis is dedicated to Catherine Virginia and Charles Vincent, my mom and dad, who have been the wind beneath my wings and answers to my prayers, for the uncompromising principles they instilled in me for direction and dedication.

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Chapter 1

INTRODUCTION

Physical fitness has been given a great deal of attention by the American public. Exercise centers, racquet clubs, and spas, with their multitude of programs, attest to the growing popularity of exercise and fitness. Advertisements showing slim, fashionably dressed people, running or swimming effortlessly, make fitness seem purchasable at any local health store. This misleading propaganda can cause the novice to have unrealistic expectations of exercise and fitness. Without proper professional guidance, the beginner may exceed his or her capabilities, and injury often ensues. This may cause the novice to avoid exercise and, as a result, never improve his or her health. Pre-exercise assessment and specific professional guidance and instruction are necessary prerequisites (American College of Sports Medicine, 1980) for any effective exercise program.

Today it appears that little has been done in the area of educating physicians to be exercise physiologists. There is a great need for doctors who have a practical and theoretical knowledge of preventive medicine. Because exercise physiology is sometimes neglected in the medical school curriculum, physicians entering practice today may have had little training in applied exercise physiology. Since physical fitness is a priority in today's society, it would be very beneficial to develop a medical curriculum that incorporated exercise physiology courses. An exploratory study was initiated at Tompkins Community Hospital's Wellness Program. This pilot study which was implemented which covered the basic physical fitness elements of cardiorespiratory fitness, functional capacity, body fat percentage, blood lipid level, strength, and flexibility. Selected fitness parameters obtained from the pilot study of these two groups of individuals were collected and compared with the established norms of the general population.

Scope of the Problem

Affiliated employees (_N_ = 53) of Tompkins Community Hospital and physicians (_N_ = 29) participated in a battery of tests designed to assess basic physical fitness. This was used as a pilot study prior to the hospital's initiation of a wellness program whose participants would all undergo similar testing. All participants were involved in exercise stress testing, along with strength and flexibility assessment. The data were collected over a 4-month period. The health fitness assessment of each individual was accomplished using a treadmill test, a skinfold body fat calculation, and a laboratory profile. Because the two groups from which the data were collected had dissimilar compositions with respect to gender and age, comparisons between groups were difficult. Therefore it was decided to compare each group's hemodynamic, respiratory, and strength parameters to the national norms for their respective gender and age groups.

Statement of the Problem

This study was conducted to compare selected cardiorespiratory, hematological, and anthropometric parameters of hospital employees and physicians to age- and gender-matched norms taken from the general population. A second purpose was to see if any differences existed between the employees and the physicians who participated in the study.

Hypotheses

1. There will be no significant differences in fitness levels of the hospital employees or the physicians who participated in the study and their appropriate age- and gender-matched national norms.

2. There will be no significant differences in fitness levels between the employees and the physicians who participated in the study.

Assumptions of the Study

1. The subjects responded fully to the instructions during the maximum oxygen consumption ($\dot{V}O_{2max}$) test.

2. Any outside fitness programs or personal activities of the participants had no significant influence on the results. These activities were difficult to monitor, and it was not possible to assess their influences on the fitness parameters being measured.

3. The subjects' anxiety when initially viewing the treadmill and breathing apparatus had no effect on the measurement of the maximum oxygen consumption.

4. No drugs used by the subjects had any effect on the fitness test results. (Each subject responded negatively when asked if he/she was taking any medication.)

Definition of Terms

1. Arterio-mean-venous oxygen difference ($a-\bar{v}O_2 diff$). The difference in oxygen content of the blood entering and leaving the pulmonary capillaries (Astrand & Rodahl, 1977).

2. Cardiac rehabilitation. The process of actively assisting the known cardiac patient to achieve and maintain his or her optimal state of health (Pollock & Wilmore, 1978).

Delimitations of the Study

1. The subjects were 53 employees and 29 physicians, aged 19-75 years, at the Tompkins Community Hospital, Ithaca, New York. All measurements were obtained during the fall semester of 1983.

2. Initially, the protocols used for a few subjects in this study were either walking or running protocols administered according to a subjective evaluation of previous medical and physical history. During the second half of the program, the substandard Balke protocol was utilized. This protocol had similar $\dot{V}O_{2max}$ values. The only difference was in testing in 2-minute stages as opposed to 3-minute stages.

3. This study was concerned specifically with the parameters of cardiorespiratory fitness, body composition, strength, flexibility, and blood lipid levels.

Limitations of the Study

1. The results of the study may only apply to those health employees and physicians in similar age groups and displaying similar characteristics, and may not be generalizable to the entire population of health care employees and physicians.

2. The results of the fitness testing only apply to the walking and running protocols used in the testing and the norms established for those tests.

3. The results may have been somewhat different if the study had been conducted in a completely controlled environment as far as humidity and temperature of the room were concerned.

4. Results may have been affected by the fact that some of the subjects, because of physical incapabilities, were unable to complete the testing.

Chapter 2

REVIEW OF RELATED LITERATURE

The first part of this literature review will focus on maximum oxygen consumption, blood pressure, body composition, and serum lipids. The latter part of this discussion will focus on the prevention of hypertension through exercise and related literature.

Since the nature of this study was to determine if health care personnel and physicians are practicing what they preach, the parameters chosen for consideration were appropriate for assessment of the subjects' current physical condition. The relative health statuses of the employees and physicians were evaluated, using body composition, blood lipids, blood pressure, and a cardiorespiratory test which has been described. Literature in the area of physician and hospital employee involvement in regular exercise programs is scarce (Sheehan, 1983).

Advances in modern technology have enabled our present-day society to live in relative comfort compared to previous generations. These advances have automated many of our home appliances and business equipment, thereby increasing the sedentary nature of our daily living habits. There is evidence that this increased state of inactivity may pose a serious threat to the body. Coronary artery disease, hypertension, hyperlipidemia, obesity, and decrease in functional capacity are all complications of the modern lifestyle. Therefore, to make the most significant impact on improving general health and reducing the risk of disease, it is imperative to deal with the total person, to alter the total lifestyle in order to achieve good health habits.

At the present time, coronary artery disease (CAD) risk factors are classified into two categories: primary risk factors, and secondary, or contributing, risk factors. The primary risk factors are those that have been shown without question to be contributory to the genesis of atherosclerosis. The secondary risk factors are not necessarily of any lesser importance, but additional research support may be needed to establish them as primary factors. To date, hypertension, cigarette smoking, and elevated blood cholesterol levels have been identified as the primary risk factors for CAD (Kramsch, 1981). Included among the secondary risk factors are conditions that can be altered, i.e., emotional stress, obesity, and physical inactivity.

Primary Risk Factors

According to the U. S. Health and Nutrition Examination Survey of 1971 to 1974, 19% of the adult population in the United States is hypertensive (Keys & Blackburn, 1972). Hypertension has been one of the most powerful predictors of CAD, and the risk increases markedly when hypertension is coupled with other risk factors. Studies to date have demonstrated the following (American Heart Association, 1980):

1. The risk of premature cardiovascular disease and death rises sharply with increased resting systolic or diastolic blood pressure.

2. Even within the established normal level of blood pressure, there are a greater number of heart attacks and strokes among the so-called high normal than in persons with lower blood pressure readings.

3. There are indications that the incidence of strokes and heart failure can be reduced in groups of patients whose high blood pressure is lowered by medication.

Secondary Risk Factors

Obesity is the best-documented alterable secondary risk factor. The relationships of body weight and skinfold thickness to the 5-year incidence of CAD in men were investigated by Keys and Blackburn (1972). They demonstrated that a higher body weight was associated with an increased risk for CAD. At 35% above ideal weight, the odds of CAD for men and women, respectively, were 1.6 and 1.4 times the risk for men and women at their ideal weight. Also, weight gain after age 25 resulted in increased risk of CAD in both sexes, independent of initial weight and other risk factors (Hubert & Castelli, 1983).

Maximum Oxygen Uptake

Cardiovascular functional capacity or performance is best quantified by the measurement of maximum oxygen uptake ($\dot{V}O_{2max}$). $\dot{V}O_{2max}$ reflects the body's ability to maximally conduct and transport oxygen from the ambient air to the working muscles during exhaustive exercise. This important physiologic reference standard serves as an index of functional capacity of the circulation and, when adjusted for body weight, of cardiovascular fitness (Solonin, 1981). The absolute magnitude of $\dot{V}O_{2max}$ correlates with the body weight, particularly lean body weight. A product of maximum cardiac output times maximum arterio-mean-venous oxygen difference ($a\text{-}\bar{v}o_2$diff), $\dot{V}O_{2max}$ increases with physical training and decreases with bed rest and aging. A sedentary 35-year-old man can increase his oxygen uptake approximately 10 times from rest to maximum exercise. This is about half the capacity of a world class endurance athlete but twice the capacity of some cardiac patients with impaired left ventricular function. With less than 10% variation in maximum heart rate and maximum systemic $a\text{-}\bar{v}o_2$diff between athletes and many cardiac patients, the nearly fourfold difference in $\dot{V}O_{2max}$ parallels difference in stroke volume and cardiac output. Thus, a cardiac patient might be unable to significantly increase stroke volume during exercise, requiring the aerobic demands of active muscles to be met entirely by increases in heart rate and $a\text{-}\bar{v}o_2$diff.

A comparison of $\dot{V}O_{2max}$ values of young and middle-aged men and women of various fitness levels can be seen in Appendix B. The data indicate that the difference in aerobic capacity is related to both age and fitness status (Cooper, 1977). Values for women are approximately 10% to 20% lower than for men (Wilmore, 1974). There is no clear-cut standard for cardiorespiratory fitness because a specific level of aerobic capacity for optimal health has not been determined. The $\dot{V}O_{2max}$ for sedentary middle-aged men falls below 40 ml/kg/min^{-1}. This value drops to 30 ml/kg/min^{-1} by ages 50 to 60. The values of 35 to 50 ml/kg/min^{-1} would seem a reasonable estimate for an adequate aerobic capacity for ages 20 to 60, e.g., values of 45 to 50 ml/kg/min^{-1} for the 20-year-old and 35 to 40 ml/kg/min^{-1} for the 60-year-old (Cooper, 1977).

Blood Pressure

Systolic blood pressure normally rises during dynamic exercise. Changes from rest to maximum exercise in males normally range from 60 to 100 millimeters of mercury (mmHg). Responses in women are generally lower, with normal increases from 20 to 60 mmHg in systolic blood pressure during dynamic exercise. Failure to achieve the lower limits of these ranges may represent inotropic incompetence and possible ventricular dysfunction in the absence of hypovolemia, beta-blocking medication, or some vasoregulatory irregularity.

Cooper (1977) observed the relationship between blood pressure and physical fitness, as determined by the length of time the subject could remain on the treadmill using the Balke protocol. He reported a consistent inverse relationship between physical fitness and systolic blood pressure. He interpreted his results to imply that physical fitness is related to a lower coronary risk profile. The study was cross-sectional in nature, with 3,000 males constituting the data base, numbers that clearly would have been impossible to obtain with a longitudinal format. More recently, similar findings have been shown with females (Gibbons & Blair, 1983).

The systolic and diastolic blood pressure values established are from published data for age- and sex-adjusted norms (Appendix B). These values can be used for educational and descriptive purposes. For example, a systolic/diastolic reading of 100/70 would indicate a very low level of risk for developing CAD. A moderate risk would be a value of 140/88. A reading of 170/105 would call for medical intervention. A high blood pressure is just one of the primary risk factors that would place an individual in a moderate risk category for developing CAD.

Body Composition

Anthropometry is the science that deals with the measurement of size, weight, and proportions of the human body. Anthropometric measures are used to predict body density and percentage of body fat.

The research leading to the development of population-specific equations has shown that age and gender are important sources of body density variation. Body density differences between men and women can be traced to essential fat variance (Behnke, 1974). In addition, population-specific equations for gender have been important because of the differences in subcutaneous fat distribution for men and women (Parizkova, 1977). The findings from the research on population-specific equations show that gender, age, and degree of fatness need to be considered when estimating body density from anthropometric variables (Lohman, 1981). Lohman also showed that the relationship between body density and subcutaneous fat is affected by gender and age. Using published data involving men and women of various ages (Laughridge & Coleman, 1975), Lohman examined skinfold thickness and body fat percentage adjusted to 1.050 g/lm (gram/lean mass). With this common body fat percentage, the skinfold thicknesses of women were lower than men, and older subjects had less subcutaneous fat than their younger counterparts. Since skinfold thickness is the primary variable used in body fat percentage equations, the analysis by Lohman showed that equations developed on one group will be biased when applied to subjects who differ in gender, age, and fatness. Therefore, when estimating body fat percentage from anthropometric variables it is important to use population-specific equations for gender, age, and degree of fatness.

Cholesterol/High Density Lipoprotein Ratio

Increased levels of blood cholesterol have been linked with substantial increase in risk for CAD (Kannel & McGee, 1976). It is acknowledged that the relationship of cholesterol to CAD is not simple, but very complex. Lipoprotein molecules are of different sizes and densities but are generally classified into one of four major categories: (a) chylomicrons,

(b) very low density lipoproteins, c) low density lipoproteins, and d) high density lipoproteins. High density lipoprotein-cholesterol (HDL-C) contains the highest proportion of protein and carries approximately 20% of the plasma cholesterol. HDL-C is thought to be responsible for carrying cholesterol away from the arterial wall back to the liver, where it is metabolized and excreted. Low density lipoprotein (LDL), on the other hand, is associated with a high risk for CAD when present in high concentrations (McMillan, 1973). Studies have shown that elevated levels of HDL-C provide some degree of protection from CAD (American Heart Association, 1981). Recently, clinicians have expressed HDL-C relative to total cholesterol, i.e., total cholesterol/HDL-C ratio, with a ratio of 5.0 or greater indicating high risk and a ratio of 3.5 or lower indicating low risk.

The age- and sex-adjusted norms for cholesterol and cholesterol/HDL ratio can be found in Appendix B. This parameter has not been validated but is estimated from published data. Further inquiry will be necessary before more definitive results can be presented.

The Role of Physicians in Exercise

The United States can be said to have become more conscious of fitness since the early 1970s. Today only one-third of American men smoke, and almost half of all adults have a personal fitness program. A fit and fully functioning body is considered a priority in our culture (Sheehan, 1983).

The medical profession has been slow in advocating personal exercise programs, and doctors have been hesitant to tell their patients how to exercise. (Fear of malpractice suits may well be a factor here.) The exercising lay population knows more about the application of psychology and physiology to fitness than do their physicians (Sheehan, 1983). However, it is important that physicians have a working knowledge of exercise physiology.

Some medical institutions are beginning to devise courses in the pathology and clinical applications of exercise (Sheehan, 1983). The purpose is to train physicians who are well-versed in the science of exercise and its clinical applications, understand the good and bad effects of exercise, and can design exercise programs for every person who comes to them for advice or treatment.

Many physicians who treat athletic injuries have never participated in sports. They are nonexercisers--overweight and out of shape (Berglund, 1983). They often tell the athlete, "You have a sprained ankle; do not do anything for 6 weeks and then come back and see me." The need for physicians with a working knowledge of exercise physiology is warranted.

Prevention of Hypertension

A program of regular dynamic endurance exercise produces a slight lowering of both systolic and diastolic blood pressure in normotensive men (Fitzgerald, 1981). Vigorous and prolonged physical activity is associated with lower blood pressure levels, decreased incidence of hypertension, and reduced focal myocardial fibrosis (Morris, 1973).

As hypertension is a strong predictor of CAD, the influence of exercise on the risk of developing hypertension was studied among Harvard alumni (Paffenbarger, 1978). Data were obtained from college student records and alumni questionnaires to assess physical activity and other characteristics as of 1962. Follow-up data were collected in 1972, and the alumni were given a questionnaire for development of physician-diagnosed hypertension during the interval (Paffenbarger, 1978). Of 14,998 men, aged 35 to 75, who were free of hypertension in 1962, there were 681 who reported hypertension by 1972. Participation in stair climbing, walking, and light sports was unrelated to age-adjusted rates of hypertension, but alumni who engaged in vigorous sports were at 27% lower risk for hypertension than men who did not. This association persisted in age groups from 35 through 75.

Low physical activity at work was associated with increased risk of acute myocardial infarction, stroke, and death due to any disease, according to a multivariate statistical model adjusted for differences in age, serum total cholesterol, diastolic blood pressure, height, weight, and smoking. Low activity in leisure time was associated with a significantly increased risk of death but not of acute myocardial infarction or stroke (Paffenbarger, 1978). Exercise levels at work and at leisure were assessed by using a single 4-option multiple choice question. Risks were significantly increased in subjects with low physical activity both at work and at leisure. Therefore, since physical activity might have a beneficial effect on other risk mechanisms such as serum lipids and promotion of cholesterol-HDL, exercise might counteract CAD through modification of blood lipid patterns.

Summary

This chapter has presented a discussion of many of the factors involved in a medical screening and physical fitness examination. In the first part of this chapter, risk factors related to coronary heart disease were covered. Within this discussion, risks were estimated to be primary or secondary factors.

Research has shown that regular exercise beneficially affects many of the risk factors associated with coronary heart disease (Fletcher, 1981). Regular exercise promotes reductions in body weight, fat stores, blood pressure, serum triglycerides, and low density lipoprotein cholesterol fractions, with increases in the protective chol/HDL ratio.

Chapter 3

METHODS AND PROCEDURES

This chapter deals with the methods and procedures for the study. It is organized according to the following topics: (a) selection of subjects, (b) testing procedures, (c) methods of data collection, and (d) summary.

Selection of Subjects

All subjects used in this study were self-selected employees and physicians affiliated with Tompkins Community Hospital, Ithaca, New York. The ages of the 59 employees and 29 physicians ranged from 19 to 75 years old. Informed consent forms were signed by each participant (see Appendix A). The subjects were not cardiac patients.

Testing Procedures

The submaximal Balke stress testing protocol was used to assess each subject's fitness level. There were six testing instruments used: the Harpenden caliper for skinfold measurement, the Beckman metabolic chart for the measurement of maximum oxygen consumption, the mercury manometer, a stethoscope, an automatic blood pressure cuff, and the Quinton treadmill. The blood analysis was performed in the hospital's hematology laboratory.

Methods of Data Collection

The 53 employees and 29 physicians used as subjects were tested on a treadmill until they elected to terminate the test (Ellestad, 1980). The data from these subjects were collected between September and December 1983.

The Balke treadmill test was used, with the subject connected to a 12-lead electrocardiogram. This test consisted of walking on a treadmill at 2.0 mph, with the surface flat during the first 2 minutes. After the first 2 minutes the incline of the treadmill was raised 2.5%, so that the subject walked just slightly uphill. At subsequent 2-minute intervals the angle was increased by 2.5%, so that the amount of work gradually increased. After 20 minutes the incline was maintained at 22.5%. The speed was held constant throughout. As the subject worked progressively harder, his or her heartbeat and blood pressure were monitored at the end of each stage (Ellestad, 1980).

To help insure accuracy and stabilization of blood pressure, two or three readings were taken. Supine and standing pre-exercise blood pressures were taken to detect any significant difference due to the subject's position. During the test a blood pressure was recorded at each work stage. During the 8-minute recovery period the blood pressure was taken at 1, 3, and 5 minutes to monitor the subject's response (American College of Sports Medicine, 1980).

Maximum Oxygen Consumption

The procedure employed for determining maximum oxygen consumption was outlined by the Beckman Company. The equipment necessary for the subject included a nose clip, mouthpiece, breathing valves, and gas analysis equipment. Each subject was allowed to take time to become accustomed to the treadmill at 2.0 mph. Then, after the subject felt comfortable, the test began. The submaximal Balke protocol was utilized. After each workload was completed, the subject was asked to decide if he/she could do another workload. The level of discomfort was graded by each subject after each workload according to Borg's Perceived Exertion Scale (Borg, 1970). Heart rate, blood pressure, and the ECG tracing were all documented at each stage of the test. The subjects were able to view the plotting of their oxygen consumption and minute ventilation on a computer plotter in front of them. When the subject elected to terminate the test, he or she was allowed to cool down slightly, and then the post-exercise analysis began for roughly 8 minutes in a sitting position.

Blood Pressure

Blood pressure was taken at the midpoint of each 2-minute stage, until the subject began to run. At that time an accurate blood pressure reading was impossible, although heart rate and ECG monitoring were continued. A portable adjustable height mercury manometer was used, along with a stethoscope over the brachial artery of the right arm. A pressure device that the technician could easily inflate and deflate helped in the determination of blood pressure.

Lipid Screening

The lipid profiles, including cholesterol and high density lipoprotein levels, were determined in the hospital laboratory a day in advance of the exercise test. The ratio of high density lipoprotein to cholesterol was analyzed according to Cooper's method by an automated analyzer. The values were compared to norms established by Cooper (1977).

Skinfold Measurements

All subjects in the investigation were measured at three selected skinfold sites, with the measurements recorded to the nearest millimeter. In order to control for interindividual measurement variation, all skinfolds were obtained by the same person.

Skinfolds were measured on each subject on the dominant side at the following sites:

1. The triceps site was determined by identifying the point half the distance between the tips of the acromial process and the olecranon process on the posterior aspect of the arm with the elbow flexed at a 90° angle. After determining the midpoint, a vertical skinfold was obtained with the arm hanging in a relaxed and extended position.

2. The suprailiac skinfold was located immediately above the iliac crest at a horizontal angle.

3. The subscapular skinfold site was located just below the inferior angle of the scapula, with the skinfold pinched at about a 45° angle from the horizontal, going medially upward and laterally downward.

Regression equations were employed for the prediction of body density from the log of the sum of skinfold thickness at three sites. These equations, developed by Durnin (1967), were for females: Body density = 1.09949 - .000929(x_2) + .0000023$(x_2)^2$ - .000139(x_6), and for males: Body density = 1.10938 - .999826(x_3) + .0000016$(x_3)^2$ - .000257(x_6).

Statistical Analysis

The mean and standard deviation of each parameter for each group were calculated and recorded. The means for each parameter across the physician and employee groups were compared to national norms. Also, for specific age and sex categories, the employee and physician groups were compared to each other.

Multiple *t* tests (Hopkins & Glass, 1978) were used to analyze the anthropometric, hemodynamic, and respiratory parameters of the 82 subjects. The subjects were classified according to age and sex, and the mean value of each parameter for each group was compared to the mean value from national norms developed by Cooper (1977). Also the data of the physician group and the employee group were compared to see if there were any differences between the two groups. The data were subjected to a Statistical Package for the Social Sciences computer program (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975) to conduct the *t* tests. The .05 level of significance was chosen for all statistical tests because this was an exploratory study. Therefore the chances of rejecting a true null hypothesis were increased due to the multiple *t* tests.

Summary

A total of 53 health employees and 29 physicians from Tompkins Community Hospital, Ithaca, New York, were investigated to assess their level of fitness. The substandard Balke treadmill protocol was used to make this assessment. Skinfold measurements, blood pressure, oxygen consumption, and blood lipid level were evaluated and compared to established norms.

Means and standard deviations were calculated for each variable according to specific age and sex classifications. Data were collected and analyzed for the 82 subjects using multiple *t* tests (Hopkins & Glass, 1978) to see if significant differences existed between the two groups and between each group and the appropriate national norms.

Chapter 4

RESULTS

There were four variables investigated in this study: maximum oxygen consumption, blood pressure, cholesterol/high density lipoprotein (chol/HDL) ratio, and body composition. The results will be discussed and compared to national norms for those variables.

The following areas were covered in this chapter: (a) employee and physician groups versus norms, (b) employee group versus physician group, and (c) summary.

Employee and Physician Groups Versus Norms

Aerobic fitness levels were determined by comparisons to two sets of norms as shown in Appendices B and C. The norms in these tables were developed from a large sample of generally healthy men and women who were tested at the Cooper Clinic in Dallas, Texas (Cooper, 1977).

Tables 1 and 2 list the means and standard deviations for the employee and physician groups, respectively, according to age and sex classifications. These were compared to appropriate population norms.

Unfortunately, there were not enough subjects available in all male and female age classifications to run the 2-tailed *t* test. Therefore, for certain age and gender groups, no tables will appear.

In the male employee classification the means for body fat percentage and $\dot{V}O_{2max}$ appeared lower than those of the

Table 1

Employees' Results

Male (Ages 20-29)	*n*	*M*	*SD*
Body Fat Percentage	4	19	7
Blood Pressure (syst/diast)(mmHg)	5	128/71	8/9
Chol/HDL ratio[a]	5	3.5	.6
$\dot{V}O_{2max}$[b]	4	39	14
Female (Ages 20-29)			
Body Fat Percentage	2	22	6
Blood Pressure	3	112/75	4/5
Chol/HDL ratio	3	3.4	.3
$\dot{V}O_{2max}$	3	35	4
Male (Ages 30-39)			
Body Fat Percentage	3	20	10
Blood Pressure	3	131/86	16/7
Chol/HDL ratio	3	4.3	.6
$\dot{V}O_{2max}$	3	43	2
Female (Ages 40-49)			
Body Fat Percentage	8	34	5
Blood Pressure	13	129/81	18/9
Chol/HDL radio	12	3.7	1.3
$\dot{V}O_{2max}$	10	24	4

[a]Total cholesterol/high density lipoprotein ratio.

[b]Maximum oxygen consumption (ml/kg/min).

Table 2

Physicians' Results

Male (Ages 30-39)	*n*	*M*	*SD*
Body Fat Percentage	7	18	6
Blood Pressure (syst/diast)(mmHg)	7	122/81	13
Chol/HDL ratio[a]	5	3.5	.5
$\dot{V}O_{2max}$[b]	7	41	7
Female (Ages 30-39)			
Body Fat Percentage	2	24	6
Blood Pressure	2	117/72	9
Chol/HDL ratio	1	2.0	0
$\dot{V}O_{2max}$	1	39	0
Male (Ages 40-49)			
Body Fat Percentage	8	19	4
Blood Pressure	9	122/76	6/5
Chol/HDL ratio	8	4.2	1.1
$\dot{V}O_{2max}$	8	42	10
Male (Ages 50-59)			
Body Fat Percentage	9	23	9
Blood Pressure	8	124/77	10/6
Chol/HDL radio	6	4.9	1.8
$\dot{V}O_{2max}$	9	34	10

[a]Total cholesterol/high density lipoprotein ratio.

[b]Maximum oxygen consumption (ml/kg/min).

population norms, although the mean for blood pressure was higher (but not significantly higher) than the norm (Table 3). For the female employee classifications there were significant ($p < .05$) differences seen in body fat percentage and blood pressure, but not in the chol/HDL ratio or $\dot{V}O_{2max}$.

In the female employees, aged 30-39, the means for chol/HDL ratio and $\dot{V}O_{2max}$ were consistent with the population norm. The body fat percentage was significantly ($p < .05$) lower than the norm, as was the diastolic blood pressure. In the next female employee group, aged 40-49, the body fat percentage and systolic blood pressure results were significantly ($p < .05$) higher than the norm. However, there were no statistically significant ($p > .05$) results noted in the chol/HDL ratio and $\dot{V}O_{2max}$. In the last female employee category, aged 50-59, no statistically significant ($p > .05$) results were noted.

Similar results were obtained from the physician group (Table 4). The means of the males, aged 30-39, were consistent with the population mean for all variables. In the male group, aged 40-49, the mean for percentage of body fat was lower ($p < .05$), while the other parameters selected were consistent with the norm. In the last group of males, aged 50-59, the mean for body fat percentage was not significantly ($p > .05$) lower than the population norm for this age.

Table 3

Tests of Means for Employees Against Norms

Male (Ages 20-29)	*n*	*M*	Norms	*t*
Body Fat Percentage	4	19	21	.30
Blood Pressure (syst/diast)	5	128/71	124/80	1.12/.80
Chol/HDL ratio	5	3.6	2.0	.44
$\dot{V}O_{2max}$	4	38	40	.84
Female (Ages 30-39)				
Body Fat Percentage	12	23	24	3.91*
Blood Pressure	13	113/72	115/77	1.09/2.12*
Chol/HDL ratio	13	3.4	1.9	.77
$\dot{V}O_{2max}$	12	29	30	.23
Female (Ages 40-49)				
Body Fat Percentage	8	34	26	3.20*
Blood Pressure	13	129/82	118/78	3.16*/1.07
Chol/HDL ratio	12	3.7	2.1	2.03
$\dot{V}O_{2max}$	10	23	28	1.85
Female (Ages 50-59)				
Body Fat Percentage	8	30	29	1.63
Blood Pressure	9	134/84	126/80	2.17/1.82
Chol/HDL radio	9	3.8	2.2	.90
$\dot{V}O_{2max}$	9	24	24	.72

$^*p < .05$.

Table 4

Test of Means for Physicians Against Norms

Male (Ages 30-39)	*n*	*M*	Norms	*t*
Body Fat Percentage	4	18	22	1.61
Blood Pressure (syst/diast)	7	122/81	122/81	.42/.46
Chol/HDL ratio	5	3.5	3.1	1.76
$\dot{V}O_{2max}$	7	41	37	.06
Male (Ages 40-49)				
Body Fat Percentage	8	19	23	3.12*
Blood Pressure	9	122/77	124/83	1.11/1.93
Chol/HDL ratio	8	4.1	2.6	.12
$\dot{V}O_{2max}$	8	42	36	.28
Male (Ages 50-59)				
Body Fat Percentage	9	23	24	.36
Blood Pressure	8	124/77	129/84	1.28/1.18
Chol/HDL ratio	6	4.9	2.3	1.00
$\dot{V}O_{2max}$	9	34	33	1.26

*$p < .05$.

The means were lower in body fat percentage and blood pressure, while the $\dot{V}O_{2max}$ and chol/HDL ratio were higher than those of the population standard, but not significantly so.

While several of the *t* tests indicated significant differences, these tests represented only a small percentage of the total number of significance tests run in this study, a percentage certainly within the limits of chance established by the overall probability level for this study. Therefore, the null hypothesis that there would be no differences in the selected parameters when the statistics for the employee and physician groups were compared to population norms was not rejected.

Interestingly, the only consistent finding obtained from the means in all age groups that were either higher or lower than the norm was in body fat percentages and blood pressure results. In all the classifications, means varied noticeably about the norm on the selected parameter investigated, but the only statistically significant findings have been previously stated.

Employee Group Versus Physician Group

The second investigation was to compare the hospital employees, in their respective age and sex categories, to the same categories for the physicians on the four parameters. The data across the four parameters investigated were subjected to multiple *t* tests, as calculated by the Statistical Package

Table 5

Comparison of Employee and Physician Groups

	Employees		Physicians		
Male (Ages 30-39)	n	M	n	M	t
Body Fat Percentage	3	20	7	18	.42
Systolic BP	3	131	7	122	.90
Diastolic BP	3	86	7	81	.17
Chol/HDL Ratio	3	4.3	5	3.5	.97
$\dot{V}O_{2max}$	3	43	7	41	
Female (Ages 30-39)					
Body Fat Percentage	12	23	2	24	.34
Systolic BP	13	113	2	117	.11
Diastolic BP	13	72	2	72	.13
Chol/HDL Ratio[a]					
$\dot{V}O_{2max}$[a]					
Male (Ages 40-49)					
Body Fat Percentage	3		8	19	.53
Systolic BP	3		9	122	.53
Diastolic BP	3		9	76	.77
Chol/HDL Ratio	3		8	4.2	.84
$\dot{V}O_{2max}$	3		8	42	.83

[a]Group sizes were insufficient for statistical analysis.

for the Social Sciences (Nie et al., 1975) computer program. The values obtained from the two groups (Table 5) were not significantly (p > .05) different on any variable.

Summary

A series of tests was used to measure the health and fitness of 53 employees and 29 physicians over a 6-month period of data collection. Four fitness parameters were evaluated to make this assessment. These parameters included the body fat percentage, blood pressure, chol/HDL ratio, and $\dot{V}O_{2max}$.

Analysis of the four parameters revealed that the means for the various age and gender groups generally did not differ significantly from those of the overall population norm. However, the body fat percentage of one physician group showed values that were significantly lower (p < .05) than the norm, and the t-test values showed that the female hospital employees, aged 30-39, had significantly lower body fat percentage and diastolic blood pressure than the norm. Because the number of significant t-test results was very small in relation to the total number of t tests conducted in the study, the null hypothesis that no significant differences exist in the health fitness status of hospital employees and the overall population as assessed by the chosen parameters was not rejected. The null hypothesis that no significant difference exists between the employee and physician groups was also not rejected.

Chapter 5

DISCUSSION OF RESULTS

One of the main purposes of this study was to investigate whether there is a difference between the health and fitness status of health care professionals and that of the general population. The parameters measured were body fat percentage, blood pressure, chol/HDL ratio, and $\dot{V}O_{2max}$. The results were shown in Tables 1 and 2.

Norms were gathered from an already established and nationally recognized aerobics clinic (Cooper, 1977), because the literature on the health fitness levels of employees and physicians is scarce. The standards set at this center are often used by other clinics as well.

This chapter focuses upon a discussion of the findings presented in chapter 4. The discussion is divided into five subheadings: (a) body fat percentage, (b) blood pressure, (c) cholesterol/high density lipoprotein ratio, (d) maximum oxygen consumption, and (e) summary.

The comparison of physician versus employee categories revealed no significant differences. This could possibly be due to their long hours and commitment to their work. Both groups appear to be alike in that their scores are slightly worse than the norm in most parameters, possibly due to a limited amount of time available for exercise.

Body Fat Percentage

In all the hospital employee categories, both male and female, except the females aged 40-49, the body fat percentage was lower than the population norm. This difference was statistically significant for the female group, aged 30-39. This was possibly due to the fact that such people are constantly busy and do a lot of walking from one department to another. In addition, due to working in the health field, their awareness of diet and activity is greater than that of the general public. However, the female aged 40-49 exception is possibly due to occupational administrative duties of this age group that require a lot of paper work.

Blood Pressure

The diastolic blood pressure was lower ($p < .05$) than the population norm in the female employee group, aged 30-39, while the systolic blood pressure for the female employee group, aged 40-49, was higher ($p < .05$) than the norm. This is possibly due to their genetic background and nutritional habits.

Furthermore, blood pressure results obtained from all age and gender classifications in the employee and the physician groups showed unreliable variability, but did not differ significantly from the population in general. The normal age-associated increase in blood pressure was also observed in the present study.

Cholesterol/High Density Lipoprotein Ratio

For all classifications studied, physician and employee, male and female, the mean for the chol/HDL ratio was higher than the population standard, indicating a less healthy status on this parameter than for the general public. However, in no classification was it in the CAD risk factor range. Perhaps this is one area, however, that should be addressed by all groups in order to improve their health status.

Recently there has been increased interest in fractionated lipoproteins as they relate to the prevalence of CAD. In particular, high density lipoproteins have been shown to be inversely related to total body cholesterol (Miller & Pollock, 1975). The prophylactic mechanism whereby HDL may help to prevent atherosclerosis is uncertain, although it has been hypothesized that HDL aids in the clearance of cholesterol from the arterial wall (Miller & Pollock, 1975).

Maximum Oxygen Consumption

In the male employee age classifications, the means for $\dot{V}O_{2max}$ were consistent with the population norms. Different results were obtained from the female employee group, aged 40-49, whose value appeared lower than the population norm but was not significantly lower. In addition, the male physician groups' $\dot{V}O_{2max}$ means were within the population standard.

$\dot{V}O_{2max}$ is dependent upon many factors, such as genetic endowment, age, sex, cardiovascular fitness, and oxygen carrying capacity of the blood, to name a few. Aerobic training can increase $\dot{V}O_{2max}$ by approximately 25% (Pollock, 1978). This increase is dependent upon the initial level of fitness, the age of the trainee, and the intensity, frequency, and length of the training session (Pollock, 1978). Therefore, the differences noticed in this study require further in-depth investigation, possibly at the histological level.

Summary

Because the nature of this study was to determine if health care personnel and physicians are "practicing what they preach," the parameters chosen were considered appropriate for assessment of the subjects' current physical condition. The relative health status of the employee and physician groups when compared indicated a variable difference in their fitness levels that was not statistically significant.

When the employee and physician groups were compared to the general population it was observed that they did differ on some of the parameters investigated, but not significantly. Therefore, due to the scant literature on this and the results of the data, it appears that the health care personnel studied are not any more or less physically fit than the general public.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

Summary

This investigation was conducted to see whether health employees and physicians were healthy and fit, by comparing their body fat percentage, systolic/diastolic blood pressure, maximum oxygen consumption, and cholesterol/HDL ratio against norms for people in the same age and gender categories. The norms were from Cooper (1977).

The study took place at Tompkins Community Hospital, Ithaca, New York. The subjects were 53 employees and 29 physicians affiliated with the institution. These 82 subjects were participants in the pilot study for a wellness program at the hospital. Fitness levels were significantly ($p < .05$) lower than the norms in the female employee group, aged 30-39, on the parameters of body fat percentage and diastolic blood pressure. In the female employee group, aged 40-49, significantly higher ($p < .05$) body fat percentage and systolic blood pressure were observed. There was no significant ($p > .05$) difference between male employees and the general population on any of the parameters measured. The male physician group, aged 40-49, had significantly ($p < .05$) lower body fat percentage than the general population, however, there was no significant consistent difference observed in any of the male physician and employee groups.

To compare employees and physicians, the data from the four parameters measured were subjected to multiple *t* tests as calculated by a Statistical Package for the Social Sciences (Nie et al., 1975) computer program. Results indicated that for each of the four parameters measured no significant ($p < .05$) difference existed between the employee and physician groups of similar age and sex classifications.

Conclusions

Within the scope of this investigation, the following conclusions were drawn:

1. A significantly ($p < .05$) lower body fat percentage and diastolic blood pressure were observed for the female employee group, aged 30-39, when compared to the population norm. In the female employee group, aged 40-49, the results indicated a significantly ($p < .05$) higher body fat percentage and systolic blood pressure than the norm.

2. The male physician group, aged 40-49, had a significantly ($p < .05$) lower body fat percentage than the population norm.

3. There was no significant ($p > .05$) difference obtained from the comparison of employees versus physicians on any of the chosen parameters.

Recommendations for Further Study

1. A study should be done incorporating a similar exercise program but using a large metropolitan hospital, where the opportunity exists to randomly select subjects.

2. A follow-up study should be conducted with the same subjects to see if they have made any progress in personal health fitness.

3. A study should be done to investigate whether health care professionals, categorized according to age and sex, are adhering to individual exercise prescriptions given at the end of their evaluation.

4. A similar study should be conducted on a large number of hospitals to investigate the medical profession and its commitment to regular exercise, using the same parameters measured in this study.

Appendix A

IN-SHAPE ASSESSMENT INFORMED CONSENT

Patient ____
(Last Name) (First) (Middle Initial)

Age at Last Birthday ______ Physician ____________________

Address ____

Telephone Number ______________________________________

1. In order to determine an appropriate plan to get In Shape, I ______________________________ hereby consent to voluntarily engage in performance testing to be performed by or under the direction of the lab director or physician.

2. It is my understanding that I will be questioned and examined prior to taking the test and will be given a resting electrocardiogram to exclude contraindications to such testing.

3. The purpose of the test is to determine the state of my heart and circulation, and the information thus obtained will help in advising me as to the activities in which I may engage. My physician or the hospital physician must grant approval for me to undergo the testing if, in his best clinical judgment, there are no contraindications to such testing.

4. I will perform an exercise tolerance test on a bicycle ergometer, a motor-driven treadmill or ______________. The work levels (effort) will begin at a level I can easily accomplish and will be advanced in stages, depending on my abilities (work capacity). The test may be discontinued at any time because of fatigue, breathlessness, discomfort, or other signs and symptoms that dictate the test be stopped. One does not wish one to exercise at a level which is abnormally uncomfortable for one; however, for maximum benefit from the test, exercise as long as is comfortable.

5. One's pulse, blood pressure, and electrocardiograms will be monitored. In addition, other tests will be performed. These tests will include oxygen uptake and other pulmonary function measures, skinfold measures, flexibility measures, and strength testing with ______________________ ____.

IN-SHAPE ASSESSMENT INFORMED CONSENT

6. I have been informed that the selection and supervision of my test is a matter of professional judgment, that there are no satisfactory alternative methods of treatment or diagnosis and that there exists the possibility of certain changes occurring during the tests. These include, but are not limited to, abnormal blood pressure, shortness of breath, fainting, disorders of the heart beat (too rapid, too slow, or ineffective) and, in rare instances, heart attack. Every effort will be made to avoid or minimize such occurrences by the preliminary examination and by observation during testing. Emergency equipment and trained personnel are available to deal with unusual situations which may arise.

7. I understand that I have the right to ask that the test be stopped at any time if I feel that I cannot continue and that my desires will be respected.

8. I understand that the explanations that I have received are not exhaustive and that other, more remote risks and consequences may arise. I have been advised that if I desire a more detailed and complete explanation of any of the foregoing, such explanation will be given me.

   I do not request such explanation. ____________________
   (Signature)

9. The information which is obtained will be treated as privileged and confidential, and will not be released or revealed to any person except my physician without my written consent. The information obtained, however, may be used for a statistical or scientific purpose with my right to privacy retained.

10. Further, I the undersigned, release and discharge Tompkins Community Hospital, its administrators, physicians, technologists, and any other connected therewith from all claims or damages whatsoever that the undersigned or his representative may have arising from or incident to this test.

11. I acknowledge that I have read this document in its entirety, that it has been read to me, and that I fully understand it. Any questions which may have occurred to me have been answered to my satisfaction.

12. I have been informed that this exercise test may be photographed or videotaped for teaching purposes or program publicity.

Date ____________________ ____
(Signature of Patient)

If consenting party is other than patient:

____________________________ ____
(Signature of Father) (Signature of Other)

____________________________ ____
(Signature of Mother) (State Relationship)

Witnesses:

____________________________ ____
(Signature) (Address)

____________________________ ____
(Signature) (Address)

Questions: ____

____

Response: ____

____

Appendix B

PHYSICAL FITNESS AND HEALTH STANDARDS

This appendix includes age- and sex-adjusted norms for the variables investigated in this study. The data are from the Cooper Clinic Coronary Risk Factor Profile Charts, which are from data collected on patients being evaluated at the Cooper Clinic (Cooper, 1977).

PHYSICAL FITNESS AND HEALTH STANDARDS FOR MEN
20 TO 29 YEARS OF AGE

	RESTING (SITTING) Blood Pressure		MAXIMUM Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	94	60	60.0	120	7.2
	102	64	51.5	142	9.6
	110	70	47.5	154	11.6
	110	70	46.5	160	12.9
	112	72	45.0	165	13.9
	116	75	43.8	172	15.3
	118	78	43.8	178	16.2
	120	78	42.5	185	17.1
	120	80	41.8	190	18.0
	120	80	41.0	195	19.1
	121	80	39.1	199	20.1
	124	80	38.2	202	20.5
	128	80	37.0	203	21.3
	130	82	36.3	207	22.3
	130	82	35.8	211	23.4
	130	84	35.6	218	25.4
	132	85	35.5	222	27.4
	136	88	33.5	229	28.6
	140	90	32.5	240	30.5
	140	90	31.5	251	32.8
	150	100	29.0	269	38.0
	158	110	22.8	300	49.0
N	367	367	371	273	248
M	124	80	40.0	200	21.6
SD	13.4	9.6	6.4	39.1	9.1

PHYSICAL FITNESS AND HEALTH STANDARDS FOR MEN
30 TO 39 YEARS OF AGE

	RESTING (SITTING)		MAXIMUM		
	Blood Pressure		Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	96	96	54.4	135	7.1
	102	68	54.4	158	11.1
	108	70	46.5	169	13.4
	110	70	45.0	175	14.8
	110	74	43.7	182	16.2
	114	76	42.5	188	17.2
	116	78	41.3	193	18.2
	118	80	41.0	197	19.2
	120	80	39.0	203	20.1
	120	80	39.0	208	21.1
	120	80	37.0	215	22.0
	122	80	37.0	220	22.8
	124	81	35.7	224	23.6
	126	84	35.7	230	24.4
	130	85	34.6	235	25.5
	130	88	33.5	240	26.4
	132	90	32.9	250	28.0
	138	90	31.5	256	29.8
	140	92	30.2	271	32.2
	146	100	27.1	289	36.0
	168	110	22.7	340	45.9
N	1615	1615	1632	1387	1223
M	123	81	37.5	217	22.4
SD	13.6	9.6	6.5	41.2	7.9

PHYSICAL FITNESS AND HEALTH STANDARDS FOR MEN
40 TO 49 YEARS OF AGE

	RESTING (SITTING)		MAXIMUM		
	Blood Pressure		Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	96	60	52.5	145	9.2
	104	70	48.0	165	13.0
	110	70	45.0	175	14.9
	110	74	43.7	186	16.6
	111	76	42.5	193	17.7
	115	78	41.0	199	18.8
	118	80	40.0	204	19.7
	120	80	39.0	209	20.7
	120	80	37.8	214	21.5
	120	80	36.3	220	22.2
	121	80	35.7	225	23.0
	124	82	35.3	230	23.8
	126	84	34.3	235	24.6
	130	85	33.6	240	25.4
	130	88	32.9	245	26.3
	131	90	31.5	250	27.4
	138	90	31.1	257	28.5
	140	92	30.2	265	30.0
	142	98	27.6	275	32.2
	150	110	24.1	295	36.1
	166	110	19.6	338	44.4
N	1880	1880	1898	1681	1537
M	124	83	36.0	226	23.4
SD	14.5	10.0	7.3	39.7	7.1

PHYSICAL FITNESS AND HEALTH STANDARDS FOR MEN
50 TO 59 YEARS OF AGE

	RESTING (SITTING)		MAXIMUM		
	Blood Pressure		Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	98	60	51.6	149	9.0
	108	70	45.4	173	13.1
	110	72	43.7	185	15.8
	114	75	41.0	193	17.4
	116	78	39.0	201	18.4
	119	80	37.0	205	19.6
	120	80	36.0	211	20.4
	120	80	35.7	215	21.4
	122	80	34.6	220	22.1
	125	80	33.5	225	22.9
	128	82	32.9	230	23.8
	130	84	32.2	235	24.6
	130	86	31.5	240	25.4
	132	88	30.8	245	26.1
	138	90	30.2	250	27.0
	140	90	29.2	255	28.0
	140	90	29.0	264	29.1
	144	95	26.2	274	30.9
	150	100	24.5	285	32.8
	160	102	21.0	300	35.9
	180	114	16.5	344	44.8
N	1073	1073	1087	942	847
M	129	84	33.6	233	24.1
SD	17.2	10.4	8.2	40.5	7.0

PHYSICAL FITNESS AND HEALTH STANDARDS FOR MEN
60+ YEARS OF AGE

	RESTING (SITTING)		MAXIMUM		
	Blood Pressure		Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	98	60	49.5	152	10.5
	108	68	44.5	173	12.3
	112	70	41.0	180	14.1
	118	72	36.6	190	16.2
	120	76	35.7	196	17.2
	120	78	35.0	201	18.0
	124	80	33.6	205	18.9
	128	80	32.2	210	19.9
	130	80	31.0	214	20.8
	130	80	30.2	217	21.5
	131	81	29.0	225	22.3
	135	84	29.0	228	23.3
	140	84	26.2	234	24.4
	140	86	25.9	240	25.4
	140	88	24.5	250	26.9
	145	90	22.7	256	28.0
	150	90	21.8	264	28.9
	152	94	20.1	268	30.1
	160	98	17.5	280	32.5
	168	100	15.7	291	35.6
	184	118	14.0	345	42.4
N	275	275	279	243	211
M	135	83	30.0	228	23.1
SD	18.3	11.0	9.1	19.5	7.2

PHYSICAL FITNESS AND HEALTH STANDARDS FOR FEMALES
20 TO 29 YEARS OF AGE

	RESTING (SITTING)		MAXIMUM		
	Blood Pressure		Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	90	56	45.0	135	7.8
	97	60	41.0	144	9.6
	100	63	38.0	150	11.6
	100	65	37.0	160	14.5
	101	68	35.7	165	15.1
	105	70	34.3	170	16.1
	106	70	33.6	170	18.3
	110	70	32.9	174	20.2
	110	72	31.5	182	23.2
	110	74	30.9	185	24.1
	112	75	30.2	190	24.9
	115	75	30.0	195	25.6
	118	78	29.6	196	26.2
	118	78	29.2	200	27.3
	120	80	29.0	210	28.2
	120	80	27.6	215	30.3
	120	80	25.3	219	33.3
	122	80	24.0	224	36.4
	130	82	21.8	251	38.5
	140	88	20.4	265	45.5
	141	90	19.2	380	51.4
N	118	118	119	68	61
M	114	74	31.1	195	25.0
SD	12.0	7.8	5.9	41.8	11.5

PHYSICAL FITNESS AND HEALTH STANDARDS FOR FEMALES
30 TO 39 YEARS OF AGE

	RESTING (SITTING) Blood Pressure Systolic (mmHg)	Diastolic (mmHg)	MAXIMUM Oxygen Uptake (ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	90	60	43.7	124	5.1
	98	60	40.0	141	10.1
	100	65	37.0	158	13.1
	100	70	35.7	165	14.8
	104	70	35.0	168	16.7
	106	70	33.6	172	18.3
	110	70	32.9	176	19.3
	110	71	31.5	184	20.5
	110	74	31.5	188	21.5
	110	75	30.2	191	22.5
	114	76	30.2	195	23.6
	116	80	29.3	200	24.6
	118	80	29.0	204	25.5
	120	80	27.6	206	26.3
	120	80	26.2	211	27.6
	120	80	25.7	218	29.0
	122	82	24.5	224	31.3
	125	85	23.1	231	34.6
	130	90	21.7	240	38.1
	140	90	21.0	255	42.9
	160	110	17.0	300	50.2
N	301	301	309	220	192
M	115	77	30.3	197	24.8
SD	13.3	9.9	6.3	36.0	11.0

PHYSICAL FITNESS AND HEALTH STANDARDS FOR FEMALES
40 TO 49 YEARS OF AGE

	RESTING (SITTING) Blood Pressure		MAXIMUM Oxygen Uptake		
	Systolic (mmHg)	Diastolic (mmHg)	(ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
	90	58	43.7	130	7.3
	100	60	37.0	158	12.0
	100	65	35.0	171	15.8
	102	70	32.9	178	17.9
	105	70	31.5	184	19.6
	110	70	30.9	190	21.0
	110	70	30.2	195	21.9
	110	74	30.2	198	22.7
	112	75	29.0	201	23.9
	114	78	29.0	205	24.9
	118	80	26.7	210	25.9
	120	80	26.2	213	26.7
	120	80	25.3	217	27.6
	120	80	24.5	223	28.2
	120	80	24.5	228	29.1
	124	80	22.9	234	30.2
	130	82	22.7	241	31.4
	132	86	21.0	252	33.7
	138	190	21.0	265	37.4
	150	194	19.2	283	43.1
	164	110	15.7	319	49.7
N	282	282	286	218	183
M	118	78	28.0	214	26.1
SD	15.7	20.3	7.1	39.4	8.6

PHYSICAL FITNESS AND HEALTH STANDARDS FOR FEMALES
50 TO 59 YEARS OF AGE

RESTING (SITTING) Blood Pressure Systolic (mmHg)	RESTING (SITTING) Blood Pressure Diastolic (mmHg)	MAXIMUM Oxygen Uptake (ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
90	58	42.5	158	10.8
100	64	35.7	170	15.9
108	69	32.9	180	18.2
110	70	31.5	192	21.0
110	70	30.2	198	22.7
115	74	30.2	202	23.9
118	75	29.0	205	25.1
120	76	27.6	214	26.1
120	79	26.2	218	27.0
120	80	25.3	221	27.7
122	80	24.5	225	28.4
128	80	24.5	230	29.6
130	82	23.6	234	30.4
130	84	22.7	236	31.4
134	85	22.7	241	32.5
140	88	21.9	249	33.4
140	90	21.0	260	34.7
142	90	20.4	267	37.1
148	192	19.2	275	39.7
160	100	17.6	295	44.4
172	110	14.4	320	52.2

	Systolic	Diastolic	Oxygen Uptake	Cholesterol	Body Fat
N	167	167	169	137	127
M	126	80	25.7	228	29.3
SD	16.8	10.6	7.8	27.3	9.5

PHYSICAL FITNESS AND HEALTH STANDARDS FOR FEMALES
60+ YEARS OF AGE

RESTING (SITTING) Blood Pressure Systolic (mmHg)	RESTING (SITTING) Blood Pressure Diastolic (mmHg)	MAXIMUM Oxygen Uptake (ml/kg/min)	CHOLESTEROL (mg %)	BODY FAT (%)
110	66	37.0	127	6.8
118	70	31.5	180	13.1
120	70	30.2	185	17.7
120	71	30.2	188	19.3
120	75	26.9	210	22.2
122	75	25.3	220	24.0
125	76	25.3	223	25.1
125	78	24.5	235	26.6
128	80	24.5	235	27.1
130	80	23.9	238	27.9
130	80	21.8	240	29.8
132	80	21.3	245	30.5
136	80	21.0	245	30.8
139	81	20.1	246	31.3
140	84	20.1	262	31.7
140	86	19.2	265	32.5
142	88	18.3	269	34.7
150	90	17.5	275	35.2
160	198	16.1	276	36.3
165	100	15.7	310	39.9
188	100	12.3	335	51.2

	Systolic	Diastolic	Oxygen Uptake	Cholesterol	Body Fat
N	46	46	46	40	32
M	135	81	22.9	237	28.3
SD	16.2	8.8	7.9	40.9	8.5

Appendix C

CHOLESTEROL/HDL RATIO NORMS

Rating[a]	Males aged ≤ 35	Males aged ≥ 36
Elite	< 2.9	< 3.4
Excellent	3.0 - 3.4	3.5 - 3.9
Good	3.5 - 3.9	4.0 - 4.4
Fair	4.0 - 4.9	4.5
<u>Mean</u>	4.5	5.0
Poor	5.0 - 6.9	5.5 - 7.4
Very Poor	7.0	7.5
	Females aged ≤ 50	**Females aged ≥ 50**
Elite	< 2.9	> 2.7
Excellent	2.5 - 2.7	2.8 - 3.1
Good	2.8 - 3.1	3.1 - 3.4
Fair	3.2 - 3.9	3.5 - 4.4
<u>Mean</u>	3.5	4.0
Poor	4.0 - 5.4	4.5 - 6.4
Very Poor	> 5.5 - 6.9	6.5

Note. Range for chol/HDL ratio is 2.0-12.0 mg/dl.

[a]Ratings are adapted from *The aerobics way* by K. Cooper. New York: Evans, 1977.

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